3.8 GEOLOGY

This section describes existing geological conditions at Ames Research Center, focusing on its topography, geology, seismology, and the make up of its soils.

A. Topography

Ames Research Center sits on a flat alluvial plain along the southwestern edge of the San Francisco Bay. The site rises gradually from north to south, rarely at more than a one per cent slope. The main topographical features are low man-made berms created to protect roads and structures from the waters of the Bay.

Because of extensive overuse of the groundwater basin beneath it, a large area of the Santa Clara Valley experienced gradual land subsidence between 1932 and 1969. At Moffett Field, the land sank between 1.5 and 2.0 meters (5.5 and 6.0 feet) during that time period. To halt the subsidence throughout the Valley, the Santa Clara Valley Water District established a program to create numerous surface reservoirs to promote artificial recharge of aquifers in the late 1960's. This program, combined with greater usage of outside water sources and control of groundwater pumping rates, has been successful in raising the water table; subsidence is no longer a serious problem in the Santa Clara Valley or at Ames Research Center. Limited fluctuation in groundwater levels during wetter-than-average or drier-than-average years, which previously might have threatened buildings, is now unlikely to cause any structural damage. Long utility lines, such as storm water channels, are more sensitive to local land subsidence, however, and have been designed to minimize any problems.[1, 2]

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[1] *Draft Environmental Resources Document for the National Aeronautics and Space Administration Ames Research Center*. 2000.

[2] *Master Plan Short-Range Projects Final Environmental Assessment*, California Air National Guard, 129th Rescue Wing. March 1997. pp 3-4 - 3-5.

B. Geology

Ames Research Center sits in the broad, gradually-sloping Santa Clara Valley, a large structural trough descending towards the San Francisco Bay between the Diablo Range to the northeast and the Santa Cruz Mountains to the southwest. The Valley's soil has been built up by alluvial deposits of gravel, sand and clay that are now more than 300 meters (1,000 feet thick).[3]

C. Soils

Surface soils along the edges of the San Francisco Bay are composed mostly of fine-grained clays and silts. Subsurface conditions documented in the logs of borings drilled previously in the area consist of varying thicknesses of medium-stiff to stiff silty/sandy clay with occasional layers and lenses of medium-dense to very dense sand and gravel. Pockets of soft/medium stiff clayey soils up to a few meters (several feet) thick were found in some borings at depths ranging from 2 to 5 meters (5 to 15 feet). The near-surface soils, which form a stiff crust because of desiccation, were found to be mostly expansive clayey soils.

The majority of Ames Research Center is underlain by Sunnyvale silty clay, which consists of silty clay to a depth of 28 to 46 centimeters (11 to 18 inches) with a dark gray color, fine texture, poor drainage, moderate alkalinity, and high fertility. The subsoil is light gray and gray calcerous silty clay to a depth of 66 to 81 centimeters (26 to 32 inches).

The western edge of the Bay View area sits on Pacheco loam, which consists of a fine sandy loam, loam, or clay loam to a depth of 36 to 46 centimeters (14 to 18 inches). Pacheco loam is characterized by its grayish-brown color, poor drainage, and moderate alkalinity and fertility. Seasonal water tables sometimes lie within as little as 0.6 meters (two feet) of the surface. The subsoil

[3] Ibid.

is moderately alkaline loam, mottled light gray in color, in a layer between 46 and 64 centimeters (18 and 25 inches) deep.

The northern end of the Eastside/Airfield area sits on Alviso clay, which consists of slightly calcareous, neutral- to moderately-alkaline soil in a layer approximately 15 to 25 centimeters (6 to 10 inches) thick. The top centimeters of soil may consist of a layer of organic material. Alviso clay is characterized by a gray to dark gray color, poor drainage and low fertility. Because the water table sits only 0.3 to 1 meter (one to three feet) below the surface, Alviso clay is usually damp. The subsoil is gray or light gray in color, calcareous, and moderately alkaline, and has a silty clay texture.

There are two areas at Ames Research Center, one on the northern end of the Bay View area and one in the middle of the Eastside/Airfield area, where soils are classified as Kitchen middens. This soil is dark gray calcareous or clay loam with ashes, shell fragments, stones and some bones mixed in.[4]

The soil types described above pose several potential issues related to construction at Ames Research Center. First, these soils are quite malleable and easy to compress, which can lead to soil compression and differential settlement around buildings. Second, the high clay content of the soil gives it a strong shrink-swell potential with seasonal fluctuations in the water table, which can stress shallow concrete slabs and pavement and cause cracking and heaving. Finally, the soil has low permeability; water passes through it very slowly. This can cause localized flood conditions during heavy rains, and can corrode untreated pipes.[5]

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[4] *Draft Environmental Resources Document for the National Aeronautics and Space Administration Ames Research Center*. 2000.

[5] Ibid.

D. Seismology

Ames Research Center is situated in the San Francisco Bay region, one of the most seismically active areas of the United States. There is very little possibility of ground-surface rupture at the Center because there are no known active faults within it, but it is located in close proximity to three active faults: the Hayward Fault 14 kilometers (9 miles) to the northeast, the Calaveras Fault 21 kilometers (13 miles) to the northeast, and the San Andreas Fault 14 kilometers (9 miles) to the southwest. There are several other faults in the Santa Clara Valley, all of which are inactive. Historically, the greatest seismic activity has been along the San Andreas Fault zone. The maximum credible earthquake expected on the San Andreas Fault is 8.3 on the Richter scale; on the Hayward and Calaveras Faults it is 7.5. Plausible seismic hazards at Ames Research Center thus include ground shaking, liquefaction, differential settlement, and lurch cracking. Potential impacts from earthquakes along these faults have been, and continue to be, addressed in siting, structural design, and construction of buildings at Ames Research Center.[6]

[6] *Draft Environmental Resources Document for the National Aeronautics and Space Administration Ames Research Center*. 2000.